New Fuels:
Gasoline and Diesel

Philip Gaudreau

ALLPOINT Marine Services, LLC
12 Burt Drive
Middlefield, CT 06455
(860) 349-1956

Introduction

- New Fuels – What are the problems and what are the remedies?
- Problems with the new fuels as they relate to the marine industry.

Vocabulary

- AKI- the fuel's ability to resist engine knock(ping)
- Cetane- measures the ignition quality of diesel fuel
- Diesel fuel- oil refined to burn in an internal combustion engine that burns oil ignited by the heat from air compression
- Gasoline- a volatile flammable liquid distilled from petroleum and used chiefly as a fuel in spark ignited engines
- Octane- a number representing the Antiknock Index (AKI) of gasoline
- Oxygenated Gasoline- Gasoline containing an oxygenate such as ethanol or MTBE. Provides chemical enleanment of the air fuel charge thereby improving combustion and lowering CO in the exhaust.
- Phase Separation- separation of a single phase gasoline into "gasoline phase" and a "water phase" if too much water is present
- Reformulated Gasoline- Gasolines, which have had their composition and/or characteristics, altered to reduce vehicular emissions of pollutants. Specifically, those gasoline's which meet the RFG requirements of the Clean Air Amendments Act of 1990.
- Volatility- a fuel's ability to vaporize or change from a liquid to a vapor

Gasoline

Gasoline is a product refined from oil. The gasoline we pump from the gas station today is a combination of this refined gasoline and many other chemicals. A 42-gallon barrel of oil produces approximately 20 gallons of gasoline. The rest is refined into diesel fuel, heating oil, propane and other petrochemicals. The US has 5 percent of the world's population yet we use 25 percent of the world energy. The marine industry accounts for about 1 percent of all gasoline sold at the retail level. We are **not** a major factor when the fuel and engine industries get together to come up with a formula that will meet all the requirements of regulations and the engine performance.

The gasoline that we buy now at the pumps is a *Reformulated* gasoline. This gasoline is an oxygenated fuel with other additives to meet the EPA Phase II requirements for areas of the country that cannot meet the CO requirements of the Clean Air Act. This went into effect in 2000. These requirements have very stringent emission reductions for gasoline.

Some problems have come up with this gasoline when used in the marine industry. The problems started before 1992. The EPA said the air in our part of the country did not meet their requirements for lowering the amount of CO in the air. In 1995 we started to get oxygenated fuel in the winter. This fuel was oxygenated with a compound called MTBE (Methyl Tertiary Butyl Ether). It was found that this caused pollution in our ground water. After 2000 it was found that we needed oxygenated fuel all year round due to Phase II of their requirements. At that time the state DEP required that gasoline sold in CT be oxygenated with something other than MTBE. It was decided that Ethanol was to be used to oxygenate our fuel. It was safer and did not pose any ground water pollution problems.

Now here is where we get into the problems the marine industry faces with today's gasoline. The problems really started when the MTBE oxygenate fuels were replaced with Ethanol oxygenated fuels. There were some mixability problems. The two fuels did not mix well and caused some problems with plugging fuel systems. Most cars did not have this problem due to the amount of fuel cars burn and the length of time the fuel sits in the tank. Now that all of the MTBE fuel is gone and even most boat owners have cleared it out of their tanks this problem seems to be going away. We

face two other problems with the new Ethanol oxygenated fuel. One problem is storage. This fuel has a very short shelf life. It is not suitable for storage of longer than 60-90 days without proper stabilization. Storage of fuel in tanks over the winter has always been a problem for the marine industry. Most people are afraid of condensation building up water in their tanks if they are not full. This is true, but other factors now come into play when thinking about fuel tank storage. Small portable tanks should be drained down and left empty for the winter. Larger tanks should be properly stabilized and left full. If you have a large tank and do not want to fill it then you should run the tank almost empty and stabilized the fuel that is left in the tank. You should always check with your marina on how they want the fuel tanks left. A tank with very little fuel in it is more of an explosion hazard than a full tank. Many yards want the tanks filled to decrease this risk.

The other problem is water. Ethanol is an alcohol. Alcohol absorbs water. This is what dry gas is. It is alcohol designed to absorb water in fuel tanks. The EPA regulates the amount of Ethanol in the fuel to a level of 10 percent. This amount of alcohol in gasoline attracts water. Gasoline will hold some water in suspension before the two separate. This is called *Phase Separation.* A gallon of standard gasoline with no additives will hold .15 teaspoons of water before the water will separate. The old MTBE oxygenated fuel would hold about .45 teaspoons of water before it would separate. Ethanol oxygenated fuels will hold 4 teaspoons of water per gallon before it separates. This is a good thing if the water stays in suspension. Small amounts of water in the fuel tanks will be absorbed and burned like dry gas. The problem comes when the ethanol has absorbed more than the gasoline can suspend. When the water level gets too high phase separation occurs and the tank now has a layer of water in the bottom. Fuel pickups are always drawing the fuel from the bottom so the engine now is trying to run on water. It has been found that this is not a serious problem for cars as their fuel tanks have closed vent systems, boats do not. The vent on boat fuel tanks is usually on the side of the hull not too far from the water line. Water coming in through the vent through splashing and from the moisture in the air can cause water to be absorbed by the alcohol in the gasoline. Another problem relates to storage. The open fuel tank vent will absorb moisture from the atmosphere. At 70 percent humidity it will take approximately 100 days to absorb enough moisture to cause phase separation.

What can we do?

The best thing we can do is to protect our engines and equipment with a fuel filter / water separator in line between the fuel tanks and the engines. Spare filters should always be kept on board along with the tools required to change the filter and a sealed container to put the old filter until you can get back to the dock where it can be properly disposed of. Other things we need to do are to not keep fuel in the tanks longer than necessary. If you know you are not going to use the boat for a month or so then keep the tanks low so you can put fresh gas in before you start using the boat again. Also be sure you stabilize the gasoline in the tanks before any long storage periods. The alcohol in the fuel will deteriorate older rubber fuel lines. If you have a boat that is more than 10 years old all of the rubber fuel lines probably should be replaced. If the boat is 5 years old then all of the fuel lines should be closely inspected and replaced if necessary. All fuel systems should be inspected at least annually. Alcohol is also a solvent. Older fuel tanks that may have a build up in them may start to have a lot of fuel filter problems. Filters will start to be plugged from the debris that has been cleaned off the sides and bottoms of tanks. It is imperative that older boats have good filters and have the filters replaced regularly. Eventually, the tanks will be cleaned and the filter problem may get better. Again, it all depends on the amount of use the boat gets and the turnover of the gasoline in the tanks.

Diesel

Diesel fuel is going through some major changes as well. Diesel fuel has undergone some changes to meet new EPA standards for pollution reduction. In 2004 the EPA passed the Clean Air Non-Road Diesel Rule. Now non-road diesels will be subjected to similar emission regulations that on road diesels have to meet. To do this all diesel fuels will have its sulfur content reduced. By 2007 the sulfur content of diesel fuel will drop from 350 ppm to 15 ppm. Ultra –Low sulfur fuels will be introduced to non-road diesel by 2010. Marine and Locomotives will get a reprieve from this new fuel until 2012. Un-Dyed diesel fuel will have these changes by 2006 so fuel bought at a regular filling station will have its sulfur reduced significantly. This low and Ultra-Low sulfur fuel will cause some problems for older diesel engines. Many older engines use the fuel as a lubricant for the injectors and injector pumps. The sulfur in the fuel helps with its lubricity. This loss of lubricity may cause some premature wearing of the older pumps and injectors. An additive will have to be added to increase lubricity for these older engines. Most newer electronically controlled engines have been designed to run on low-sulfur fuels. Europe has had low-sulfur fuels for years.

Biodiesel is one source for increased lubricity and cleaner burning engines. This is a mixture of regular diesel fuel and fuel made from biomass. Usually the biomass is a vegetable oil. Peanut oil was the original diesel engine fuel. Adding just one percent biofuel into petroleum based diesel fuel increases lubricity by 65 percent. Biodiesel can be bought locally but it is not common yet. Biodiesel is rated by the amount of biofuel mixed with #2 diesel fuel. B20 has 20 percent biofuel where B100 is 100 percent biofuel. If you want more information on biodiesel go to www.biodiesel.org.

Where to Get More Information

- Fuel regulations- EPA website- www.epa.gov
- National Marine Manufacturers Association
  444 North Capitol Avenue N.W. Suite 645
  Washington, DC, 20001
- Gasoline FAQ – In depth understanding of gasoline-
  www.faqs.org/faqs/autos/gasoline-faq/part1/
- Changes in Gasoline III 1996 and 2000 Supplement-
  www.ethanolrfa.org
  Click on the auto mechanic tab
- Biodiesel information- www.biodiesel.org